Digital University Research Aptitude Test (DRAT)

DRAT comprises two stages:

1. **DRAT-Common (DRAT-C)**

DRAT-C is an aptitude test common to all PhD applicants. It is conducted as an AI- and human-proctored online examination, which candidates can take from their homes. Candidates who score a minimum of 50% in DRAT-C will qualify to appear for the subject-specific DRAT. A relaxation of 5 % marks will be allowed in the entrance examination for the candidates belonging to SC/ST/OBC/differently-abled category, Economically Weaker Section (EWS)

DRAT-C is a multiple-choice question (MCQ)-based entrance examination with a total of 35 marks. It evaluates candidates across four key areas with the following mark distribution: English Comprehension (5 marks), Quantitative Aptitude (10 marks), Research Aptitude (10 marks), and Analytical Aptitude (10 marks). The English Comprehension section includes questions on reading comprehension, vocabulary, grammar, sentence correction, synonyms, and antonyms. Quantitative Aptitude assesses numerical ability through topics such as number systems, percentages, profit and loss, ratios, averages, time and work, algebra, and data interpretation. The Research Aptitude section covers research fundamentals, types of research, research design, hypothesis testing, sampling methods, data collection, referencing, and research ethics. Analytical Aptitude tests logical reasoning skills through pattern recognition, series and sequences, syllogisms, analogies, data sufficiency, and critical reasoning. Total: 35 marks

2. **DRAT-Subject specific (DRAT-S)**

The DRAT-S will be based on the specific research area applied for, under the respective schools or recognized research centers of Digital University Kerala. Candidates who qualify the DRAT-Common (DRAT-C) with a minimum of 50% will proceed to the DRAT-S (subject-specific) examination, followed by an interview. DRAT-S and interview will be conducted at Digital University Kerala, Thiruvananthapuram.

The detailed syllabus for DRAT-S is given below. (Total: 35 Marks)

School of Computer Science and Engineering (SoCSE)

Test Code: SoCSE_DRAT01

Research areas: Machine Learning, Deep Learning

Syllabus: Computer science fundamentals covering mathematical foundations of computing such as linear algebra (vector space, matrices, inner product space, normed vector space, eigenvalues, eigenvectors, systems of linear equations and solutions, LU and singular value decomposition), probability and statistics (Bayes' theorem, probability distributions, hypothesis testing), and optimization techniques (gradient descent, constrained and unconstrained optimization). Programming, data structures, and algorithms include programming in Python, basic data structures, searching and sorting, and graph algorithms. Database management covers the ER model, relational model, SQL, integrity constraints, indexing, data transformation including normalization, sampling, and compression. The machine learning section includes supervised learning (regression, classification, SVM, decision trees, random forests, ensemble methods), unsupervised learning (clustering, dimensionality reduction using PCA and LDA), reinforcement learning, and model evaluation metrics. Deep learning covers neural networks (perceptron, MLP, backpropagation), convolutional neural networks (CNN), recurrent neural networks (RNN), LSTM, GRU, transformers, and large language models (LLMs).

Test Code: SoCSE_DRAT02

Research areas: Computer Networks and Security

Syllabus: Computer science fundamentals covering mathematical foundations of computing such as linear algebra (vector space, matrices, inner product space, normed vector space, eigenvalues, eigenvectors, systems of linear equations and solutions, LU and singular value decomposition), probability and statistics (Bayes' theorem, probability distributions, hypothesis testing), and optimization techniques (gradient descent, constrained and unconstrained optimization). Programming, data structures, and algorithms include programming in Python, basic data structures, searching and sorting, and graph algorithms. Analysis of algorithms (algorithm efficiency, design techniques, computational complexity), computer organization and architecture (computer structure, instruction execution, memory hierarchy, I/O interface), theory of computation (automata, formal languages, Turing machines, computational complexity), operating systems (processes and threads, memory management, file systems, concurrency, system security), and computer networks and security (network protocols, addressing, routing, transport mechanisms, cryptography, security).

School of Digital Humanities, Library and Information Sciences (SoDHILA)

Test Code: SoDHILA_DRAT03

Syllabus: Management concepts and functions; organizational behavior elements such as personality, perception, motivation, leadership, group dynamics, communication, organizational culture, change management, and stress management. HR planning, recruitment, training, performance management, compensation, industrial relations, employee engagement, strategic HRM, and HR analytics, business ethics and corporate governance, statistics for management, operations research, strategic management,

entrepreneurship development, marketing management, financial management, operations management.

School of Digital Sciences (SoDS)

Test Code: SoDS_DRAT04

Research areas: Scientific Computing, Computational Nonlinear Dynamics

Syllabus: Mathematics fundamentals such as calculus, linear algebra, discrete mathematics, differential equations, and numerical methods, along with computer basics and programming.

Test Code: SoDS_DRAT05

Research areas: Computational Chemistry, AI in Molecular Modeling

Syllabus: Organic chemistry topics include reaction mechanisms, name reactions, stereochemistry, aromaticity, pericyclic reactions, spectroscopy, and retrosynthesis. Medicinal chemistry and drug discovery topics span drug design and development, structure–activity relationship (SAR), pharmacokinetics, target identification, drug action mechanisms, virtual screening, pharmacophore modelling, and ADMET prediction. Computational chemistry components comprise molecular mechanics, quantum chemistry, density functional theory (DFT), and molecular dynamics. Machine learning and deep learning in chemistry involve supervised and unsupervised learning, regression, classification, clustering, neural networks, QSAR/QSPR models, graph convolutional networks (GCN), transfer learning, and model interpretability.

Test Code: SoDS_DRAT06

Research areas: Geospatial Analytics, Geo-AI, Geostatistics, Spatio-temporal Prediction

Syllabus: Mathematics fundamentals such as calculus, linear algebra, discrete mathematics, differential equations, numerical methods, and basic programming. Topics in chemistry include organic chemistry (reaction mechanisms, name reactions, stereochemistry, aromaticity, pericyclic reactions, spectroscopy, retrosynthesis), medicinal chemistry and drug discovery (drug design and development, SAR, pharmacokinetics, target identification, drug action mechanisms, virtual screening, pharmacophore modelling, ADMET prediction), and computational chemistry (molecular mechanics, quantum chemistry, DFT, molecular dynamics). Machine learning and deep learning include supervised and unsupervised learning, regression, classification, clustering, neural networks, QSAR/QSPR models, GCN, transfer learning, and model interpretability. Geospatial topics include GIS and remote sensing fundamentals, spatial data models (vector and raster), geospatial data processing, spatial interpolation and visualization, probability and statistics for spatial data, spatial autocorrelation, spatial

regression, spatial point pattern analysis, machine learning and deep learning applications in geospatial sciences, spatio-temporal prediction using time series analysis, data modelling, change detection, and big data analytics. Applications include land use and land cover change prediction, soil and crop monitoring, climate and hydrological modelling, urban growth analysis, infrastructure planning, and disaster risk assessment.

School of Electronic Systems and Automation (SoESA)

Test Code: SoESA_DRAT07

Research areas: Biomedical Signal/Image Processing (Deep Learning), Real-time Underwater Signal Processing, Synthetic Aperture Radar (SAR) Imaging

Syllabus: Signals and systems, digital signal processing (DSP), digital image processing (DIP), biomedical signal processing, machine learning and deep learning techniques for signal and image analysis.

Test Code: SoESA_DRAT08

Research areas: Ultrasonics, Biosensors, Physical Sensors

Syllabus: Basics of sensors including physics, characteristics, and applications; electric networks including node and mesh analysis, superposition, Thevenin's theorem, Norton's theorem; electronic devices covering energy bands in intrinsic and extrinsic semiconductors, equilibrium carrier concentration, direct and indirect band-gap semiconductors, diffusion current, drift current, mobility, resistivity, carrier generation and recombination, Poisson and continuity equations, PN junction, Zener diode, BJT, MOS capacitor, MOSFET, LED, photodiode, solar cell; analog circuits including op-amp based amplifiers, summers, differentiators, integrators, active filters, Schmitt triggers, oscillators; digital circuits covering binary, integer and floating-point numbers, Boolean algebra, minimization of functions, logic gates and static CMOS implementations, arithmetic circuits, multiplexers, decoders.

DUK Recognized Research Centre – CMET Thrissur

Test Code: CMET_DRAT09

Research areas: Sensors and Actuators, Graphene and 2D Materials, Energy Storage Technologies

Syllabus: Classification of materials including metals, ceramics, polymers, and composites; mechanical properties such as stress-strain response, elastic, anelastic, and

plastic deformation at room temperature; electronic properties including free electron theory, Fermi energy, density of states, elements of band theory, semiconductors, Hall effect, dielectric, piezoelectric, and ferroelectric behavior; magnetic properties including origin of magnetism, paramagnetism, diamagnetism, ferromagnetism, ferrimagnetism; thermal properties such as specific heat, thermal conduction, thermal diffusivity, thermal expansion, thermoelectric effects; optical properties including refractive index, absorption, transmission of electromagnetic radiation, with examples of materials and their applications; and electronic devices including energy bands in semiconductors, carrier transport by diffusion and drift, mobility and resistivity, generation and recombination of carriers, Poisson and continuity equations, PN junctions, Zener diodes, BJTs, MOS capacitors, MOSFETs, LEDs, photodiodes, and solar cells.